How Large Language Models Can Support Learning

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University Canada West

MBAR 661: Academic Research Project

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Land Acknowledgement

We acknowledge that the territories on which UCW and its campuses are situated are the traditional, ancestral and unceded territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish) and Se l̓ í l̓witulh /səlilwətaɬ (Tsleil –Waututh) Nations. We are grateful for the opportunity to live, work, and play on these lands and to the Indigenous Nations who have cared for the land since time immemorial .

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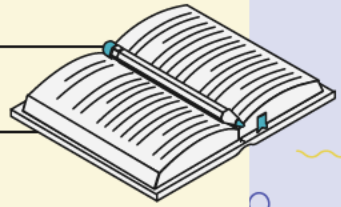
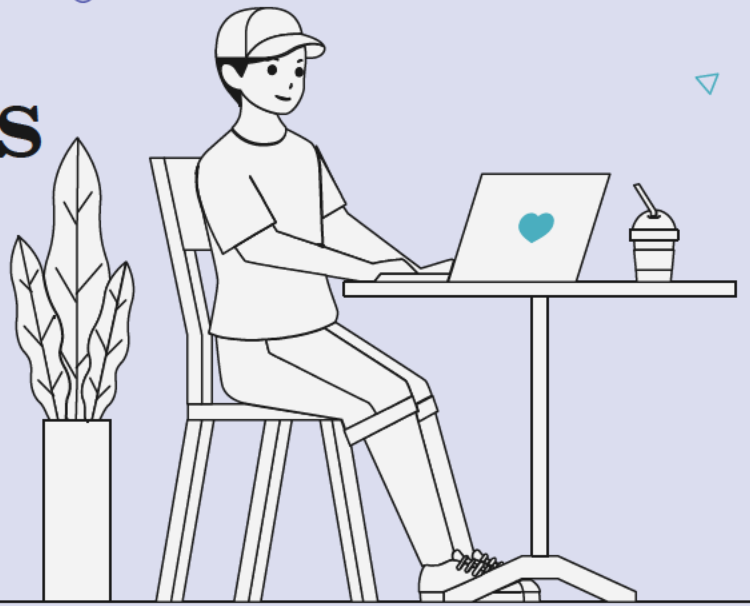


Evolution of Educational systems

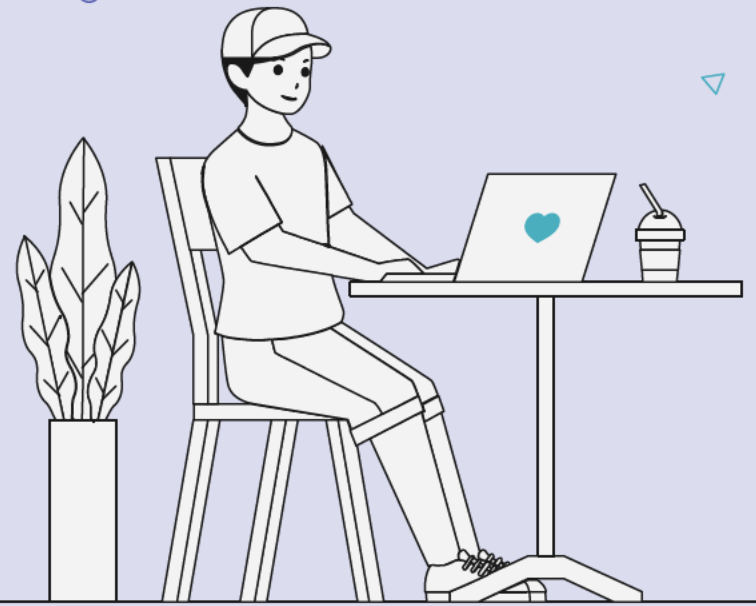


AI has transformed the traditional learning systems

LLMs are addressing the limitations of traditional education

LLMs have advanced NLP tools & generative skills – More like ‘thought partners’ for learners

Research objectives and questions



Research Gap

Lack of **empirical studies/evidence-based understanding** of the application of LLMs in learning

Current research ⟹ **pilot studies / Initial researches**

No insights from **actual classroom deployments**

Research objectives

To analyse the impact of LLMS on supporting learning processes

To explore methods of integrating LLM-based tools in educational settings

To identify potential improvements in LLM feedback systems

Research questions

How can LLMs be effectively integrated into learning environments?

What are the specific features and techniques of LLMs that could support the goals of education?

How does the use of LLMs in educational context impact students' critical thinking and problem-solving skills?

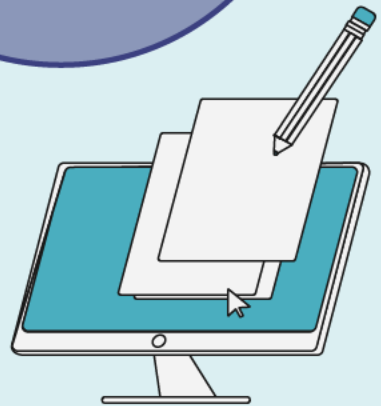
Methodology

Approach

Systematic Literature Review

Robust Selection and Screening Process

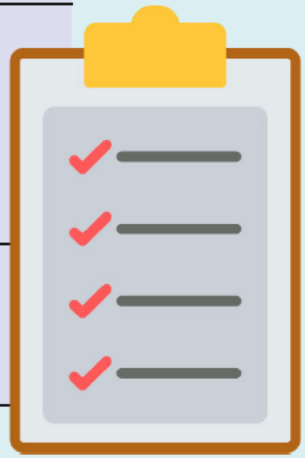
Keywords, Synonyms and Search Strings Formulated



Key Databases

- University Canada West Publication Finder
- Directory of Open Access Journals (DOAJ)
- ScienceDirect
- Google Scholar
- Academic Search Ultimate
- PubMed
- Jstor
- Sage Open

Inclusion Criteria	Exclusion Criteria
• Peer reviewed academic articles	• Book chapters, conference papers, reports, dissertations and theses, other opinion pieces
• Published in the last 5 years	• Articles not solely focused on LLM's application in education
• Articles covering application, benefits, limitations and future trends of usage of AI & LLMs in education	• Not peer reviewed or not published with the last 5 years
• Published in English	



01

Initial searches through keywords

Keywords, synonyms, and search strings

02

Screening of titles & abstracts

Screened using Notion

03

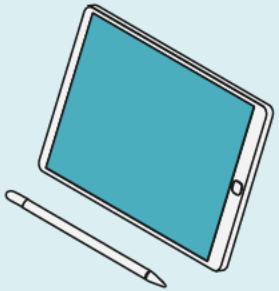
Full-Text review

Fitting the inclusion criteria

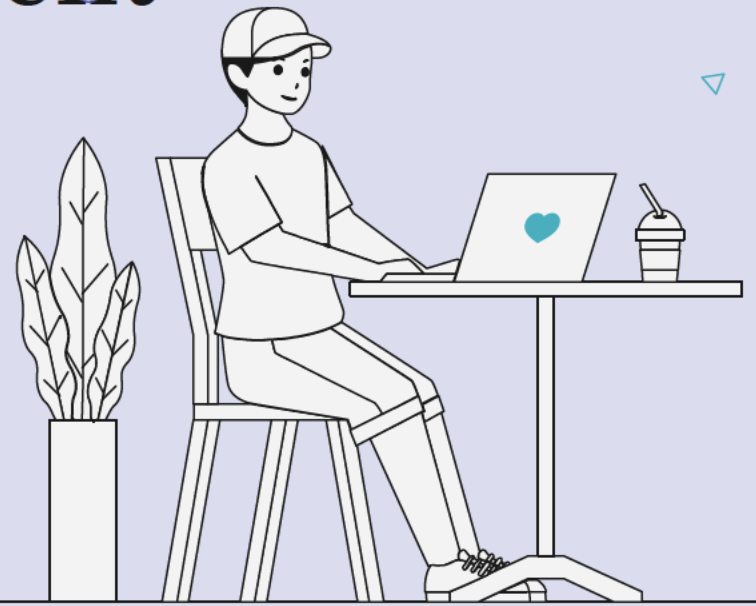
04

Extraction of Data and Synthesis

52 articles were scrutinized to extract data relevant to research themes



Role of LLMs in Different Modes of Learning



Existing literature support the research themes & findings well. Only several examples are brought in due to time constraints

Theoretical frameworks that assisted the research

- To lay down a foundation for the main concepts involved in the study
- To provide validity to the concepts discussed
- To provide a sense of origin or understructure

Diana Laurillard's Conversational Framework

To understand the different types of learning

Bloom's Taxonomy

To understand the objectives of learning

In-Person Classroms

Visualizing classroom activities, especially through Learning Stream **Plots**

Use of multi modals in science learning to create visual explanations and experiments

Assistance in pre-lab activities to encourage critical thinking and innovation

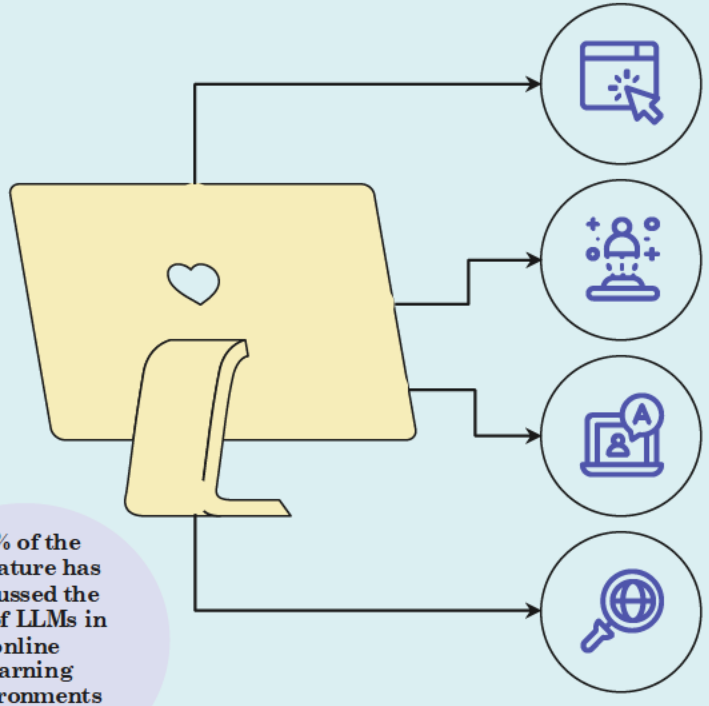
Track errors and discrepencies in lesson plans

Diagram creation and interpretaion for ease of learning

Critical identification of gaps in science models and enhancing creativity

29% of the literature has discussed the use of LLMs in physical classrooms

Online/Asynchronous Learning - Learners



Auto-generation of content, questions, responses & feedback

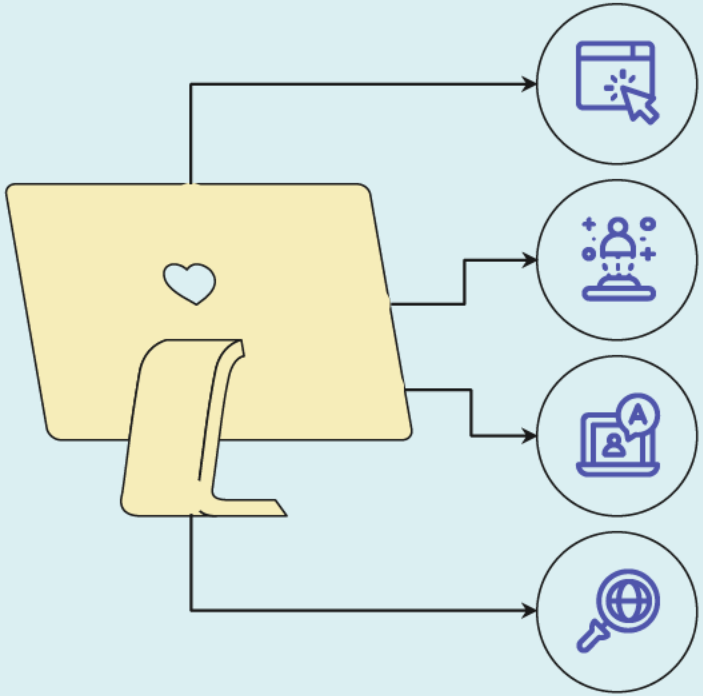
Conversational agents for development of language skills, brainstorming & to ask theoretical questions

Grading student performance and providing real-time feedback

Creation of assignments, exams, assessments that suit individual needs

59% of the literature has discussed the use of LLMs in online elarning environments

Online/Asynchronous Learning – Educators



Assessing the quality and knowledge and cognitive presence phases of students

Use of Practice Inquiry models to assess discussion posts

Use of GPT-4, GPT-3.5, Google's PaLM 2, and Anthropic's Claude 2 for essay scoring

Tailored feedback for unique drawbacks of students

Self-Directed Learning

Organize self-directed learning schedules

Summarizing long materials, finding resources, structuring assignments, and providing feedback

Sharpening writing skills

Simplyfing complicated subject matters – Science and medical studies

Easy access to current content

Benefits of using LLMs in Learning

Personalization

Tailoring content/feedback/tutoring to match student needs

Enhanced motivation, engagement, and learning enjoyment

Gamified activities and tailored feedback that prevents comparison

Accessibility & Inclusion

By passing barriers in the traditional systems

Resources for learners with disabilities or language barriers

24/7 availability

Promoting Lifelong Learning

Independent learning environments and freedom to learn

Collaborative Learning

LLMs as moderators

Facilitating critical discussions

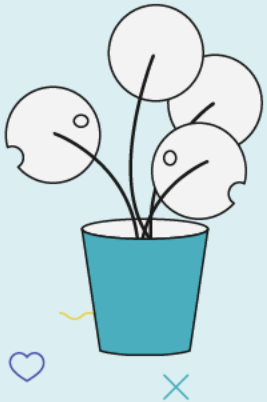
Enhancing teamwork

Increased Efficiency & Scalability

Automation of routine tasks

More time for mentoring

Path to Open Educational Resources



Limitations of using LLMs in Learning

Issue of Over-reliance

Complexity and Inaccuracy of Content

Lack of clarity & relevancy
Risk of Hallucinations"
Outputs are rather conceptual and not evidence-based

Over-reliance hinders creativity
Lack of authenticity and individuality of work produced
Lack of deep understanding of learning

Lack of Digital Literacy

In both educators and learners
Unable to get the optimal use of LLMs.
Lack of practical efficacy due to absence of empirical studies and experiments

Authorship & Intellectual property rights

Ambiguities in attributing authorship to AI generated work

Data Privacy

Possibility of leakage of private data
Lack of robust anonymization

Biases resulting from training data

Reinforcing streotypes

Ethical Concerns

Strategic Recommendations

To Mitigate the Effects of Limitations:

Regulatory frameworks

Socio-legal frameworks for the usage of LLMs
GDPR compliance, Data anonymization, & consent
Using LLMs within controlled environments

Addressing biases and improve accuracy

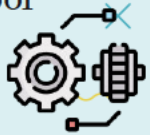
Fine-tune LLMs

- To match different languages & cultural contexts
- To suit for the different academic standards and prevent 'one-size-fits-all' content
- Refine prompts to reduce 'hallucinations'

Enhancing prompt engineering skills

Train both learners and educators to craft good prompts using CRISPE framework

Integrate prompt engineering to school syllabuses



Improve digital literacy

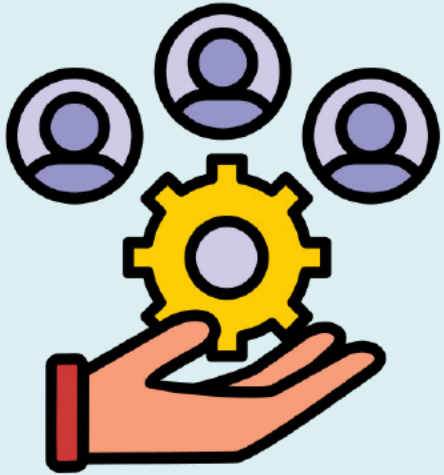
To Promote Responsible Usage:

Promote academic integrity

Introduce institutional policies for usage and attribution of LLMs

Encourage to disclose AI assistance in publications

Curate assessment in a way to reduce the integration of LLMs in final outputs

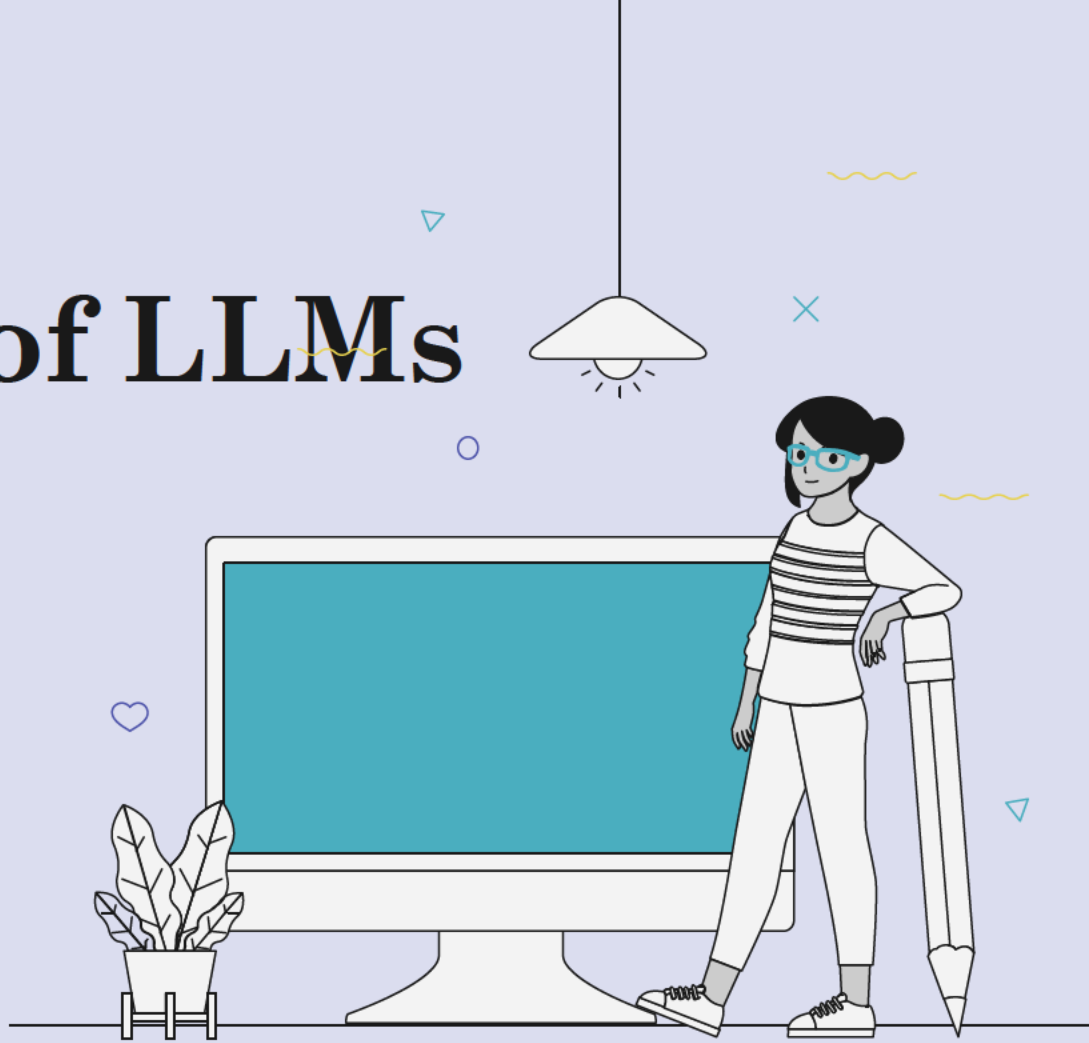


Promote Empirical validity

Execute experiments in actual, real-world classroom settings to add value to the knowledge base of LLMs

Include the main stakeholders in the design and development of LLMs

Future of LLMs



Increased personalization through RAG systems

01

LLMs using RAG systems for more adaptive content

Advanced Multimodal LLMs

02

Focusing on motivation of users

Make LLMs cognitive partners

03

Develop LLMs to have enhanced social-emotional skills and shift to the role of collaborators

Future Research Directions

Go beyond pilot studies and conduct **large-scale and real-world empirical studies.** Include Longitudinal studies to assess long term impacts.

Develop and test **ethical frameworks and data governance models**

Research anonymization techniques.

Design and develop curriculums to include prompt engineering.

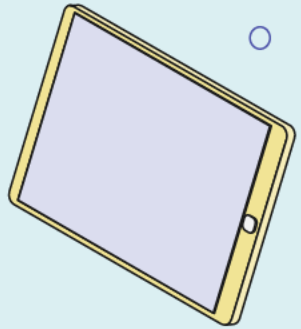
Go beyond mere application of LLMs in education and research into how they can be transformed in to **'cognitive partners'**

Focus shift towards using LLMs to **bridge equity gaps in education**

Conclusion & Key Takeaways

Education has faced a significant evolution to go beyond the traditional barriers

LLMs are a driving force behind this evolution



The review has confirmed several benefits of using LLMs in education settings

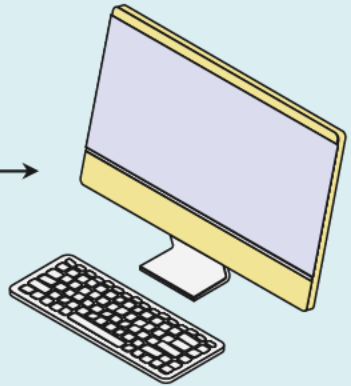
However, despite these benefits, understanding the limitations of LLMs is vital

Finding solutions to overcome these challenges include introducing legal & ethical frameworks, developing digital skills and promoting empirical validity

LLMs supplement and enhance the learning experience

LLMs support the learners & educators but do not replace them

LLMs must complement human cognitive skills and not supplant them



Human intervention plays a key role in achieving optimal results out of the LLMs

Thank you!

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